United States Department of Agriculture

NEBRASKA SUPPLEMENT TO CONSERVATION ENHANCEMENT ACTIVITY E590A

CONSERVATION STEWARDSHIP PROGRAM

Improving nutrient uptake efficiency and reducing risk of nutrient losses

Conservation Practice 590: Nutrient Management

APPLICABLE LAND USE: Crop (Annual & Mixed); Crop (Perennial)

RESOURCE CONCERN ADDRESSED: Water Quality Degradation

PRACTICE LIFE SPAN: 1 year

State Criteria

This enhancement requires a current soil test and the use of two or more nutrient use efficiency strategies or technologies.

Soil Sampling and Analysis

1. Soils shall be sampled and analyzed in accordance with Practice Specification for Nutrient Management (590-PS) or NebGuide (G1740) "Guidelines for Soil Sampling".
2. All soil samples must be taken prior to applying fertilizer or manure.
3. If applicable, manure shall be sampled and analyzed annually following University of Nebraska recommendations. See NebGuide (G1450) "Sampling Manure for Nutrient Analysis" and NebGuide (G1780) "Manure Testing: What to Request".
4. Nutrient application rates are within University of Nebraska Lincoln (UNL) recommendations based on soil tests and established yield goals considering all nutrient sources (refer to Practice Standard (590-CPS) and Practice Specification (590-PS) for Nutrient Management).

Nutrient Use Efficiency Strategies or Technologies (Use 2 or more)

1. **Use Enhanced Efficiency Fertilizers (EEF) products with 1 or more nutrient applications to supply at least 50% of the pre-emergent and early post emergent nitrogen requirements. These include:**
   - Nitrification inhibitors – [2-chloro-6-(trichloromethyl) pyridine] Nitrapyrin, dicyandiamide (DCD), Pronitridine
   - Urease inhibitors - N-(n-butyl) thiophosphoric triamide (NBPT)
   - Polymer Coated Urea
   - Sulfur Coated Urea
   - Urea-Formaldehyde Products (Methylenediurea (MDU), Dimethylenetriurea (DMTU), etc.)
   - Isobutylidene Dirurea
   - Triazone

There are currently no enhanced efficiency phosphorus products recognized in Nebraska.

2. Split applications of nitrogen based on the Late Spring Nitrate Test (LSNT)

Sampling Procedure & Analysis:

1) Soil samples for the LSNT should be taken to a depth of 12 inches when the corn is 6 to 12 inches tall.
2) Collect a minimum of 15 cores for each sample according to the following. If the field has had manure applied, 20-25 cores should be collected.
   a. Samples should be collected for each management zone and should never represent an area greater than 40 acres. Guidance for establishing management zones can be found in the Practice Specification for Nutrient Management (590-PS) or NebGuide (G1740) "Guidelines for Soil Sampling".
3) Immediately send samples to laboratory for nitrate analysis. Analyses should be conducted by laboratories that have successfully met the requirements and performance standards of the Soil Science Society of America.
4) Refer to Practice Specifications for Nutrient Management (590-PS) or Iowa State University Extension Publication CROP 3140 "*Use of the Late Spring Soil Nitrate Test in Iowa Corn Production*" available at: https://store.extension.iastate.edu/Product/5259 .

Interpretation:

Manured soils, first-year corn after alfalfa and second-year corn after alfalfa – Soils that have received recent application of animal manures or have decaying sods with alfalfa roots seem to mineralize more plant-available N after the time of soil sampling than do other soils. These soils are treated as a separate category when making N fertilizer recommendations. These recommendations are given in Table 1.

1) The first step for making recommendations from Table 1 is to decide whether the top half of the table or the lower half of the table best describes the current prices for grain.

Table 1: Nitrogen fertilizer recommendations for manured soils[a] and corn after alfalfa

Grain & Fertilizer Prices	Soil Test Nitrate	Recommended N Rate	
		Excess[b] Rainfall	Normal Rainfall
	(ppm N)	--------Lb. N/ acre-------	
Unfavorable (1 bu buys 7 lb. of N)	0-10	90	90
	11-15	0	60
	16-20	0	0[c]
	>20	0	0
Favorable (1 bu buys 15 lb. of N)	0-10	90	90
	11-15	60	60
	16-25	0	30
	>25	0	0

[a]A field should be considered manured if animal manures were applied with a reasonable degree of uniformity since harvest of the previous crop or in 2 of the past 4 years.
[b]Rainfall should be considered excess if rainfall in May exceeded 5 inches.
[c]Addition of 30 lb. N/acre may have no detectable effects on profits, but producers could reasonably elect to apply this rate.

2) The second step is to decide whether the "excess rainfall" column or the "normal rainfall column of the table best describes weather conditions before the soils were sampled.
3) The third step is to use the results of the soil test to select the appropriate N rate specified. Interpolation between specified N rates is appropriate when site conditions fall between those given.

Corn after soybean and corn after corn

1) The first step in making a fertilizer recommendation for this crop category is to select a critical concentration for nitrate (i.e. the concentration that distinguishes between adequate and inadequate supplies of available N). A critical concentration of 25 ppm-N is appropriate in absence of additional information.
2) The second step is to adjust the critical concentration if excess rainfall occurred at the site shortly before the soils were sampled. Reducing the critical concentration by 3-5 ppm is advised if rainfall is more than 20 percent above normal amounts between April 1 and time of soil sampling.
3) The third step is to estimate fertilizer needs by subtracting the concentration of soil-test nitrate (ppm-N) from the chosen critical concentration (ppm-N). This value is then multiplied by 8. A factor of 8 is used because studies have shown that it usually takes about 8 lb. of N/acre before planting to increase soil-test nitrate-N by 1 ppm.

   - Example: A soil test of 15 ppm and critical concentration of 25 ppm results in a recommendation of 80 lb. of N per acre to be applied.

     (25 ppm – 15 ppm) x 8 = 80 lb. N/acre needed

3. Use in-season plant tissue sampling and analysis as a complement to soil testing. Use one of the following methods:

1. Real Time Monitoring of Crop Nitrogen Status using a Chlorophyll Meter - The chlorophyll meter allows fine-tuning nitrogen management by monitoring leaf greenness throughout the growing season allowing early detection of potential nitrogen deficiencies so that they may be corrected before a yield reduction occurs. They work best for situations were nitrogen can be incrementally applied to the growing crop, such as with fertigation, but can also be used to time the application of supplemental nitrogen using high clearance application equipment.
   1) Apply ½ to ¾ the recommended nitrogen rate prior to planting.
   2) Fertilize reference strips within the field with the full recommended rates plus 20%.
   3) Multiple reference strips should be established across the field to account for in-field variability.
   4) Measure canopy nitrogen status beginning at the V10-V12 growth stage using the following procedure and monitor crop status on a weekly basis until tassel or until no additional nitrogen will be applied.

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Sampling Procedures & Analysis:

1) Chlorophyll meter readings should be compared at a minimum of three locations in each field.
2) At each location, the average reading of 30 plants from the reference area and the adjacent bulk field should be compared. Avoid taking readings from plants that do not represent typical plant spacing.
3) The same leaf should be sampled from each plant. Avoid very old and very young leaves.
4) Take reading on about the same location on each leaf. It works well to collect the reading from a point one-half the distance from the leaf tip to the collar, and halfway between the leaf margin or edge and the leave mid-rib.

Interpretation of Chlorophyll Meter Readings:

1) After recording the average meter readings from the bulk field and reference area at several location in each field, a N sufficiency index can be calculated as follows:

$$\text{Sufficiency Index} = \left[\frac{\text{Average Bulk Reading}}{\text{Average Reference Strip Reading}}\right] \times 100\%$$

2) UNL Extension indicates that a sufficiency index lower than 95% indicates an N deficiency that may lead to a yield reduction and should be corrected.
3) For additional information refer to UNL NebGuide (G1632) "Using a Chlorophyll Meter to Improve N Management".

2. Plant Tissue Testing & Analysis –Plant tissue analysis can be an important tool in diagnosing crop growth problems and, when coupled with soil testing, useful in refining nutrient inputs. The primary limitation with this method is the lag time from submitting the sample to the lab and getting the results.

Sampling Procedures & Analysis:

1) Collecting and appropriate, representative plant sample is essential for accurate lab analysis. Multiple sub-samples should be collected at random from representative areas in the field and combined into a single sample for analysis (follow the same protocol you would for collecting soil samples). If sample size is too large, cut plant parts into smaller sections, mix thoroughly, and collect a sub-sample to send in for analysis.
2) For corn prior to tassel the youngest mature leaf from 15-20 plants should be collected for a sample.
3) Dirty or dusty samples should be lightly rinsed to remove soil particles from the tissue surface. Do not over-rinse as soluble nutrients may be leached out.
4) Samples should be air dried or placed in a paper bag for shipping.
5) Contact the laboratory doing the analysis for additional information on sampling and analysis.

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3. Cornstalk Nitrate Testing and Analysis

Sampling Procedures & Analysis:

1) Stalks should be sampled between one and three weeks after black layers have formed on 80% of the kernels.
2) Each sample will consist of fifteen 8-inch stalk segments taken from 6 inches above the soil surface:
   a. Samples should be collected for each management zone and should never represent an area greater than 40 acres. Guidance for establishing management zones can be found in NRCS (590-PS) or NebGuide (G1740) "Guidelines for Soil Sampling".
3) Wrap samples in paper, rather than plastic, to avoid mold growth.
4) Immediately send samples to laboratory for nitrate analysis. Analyses should be conducted by laboratories that have successfully met the requirements and performance standards of the Soil Science Society of America.

Interpretation of the Test Results:

Use the following table to determine management suggestions. If any of the results are in either the low or excess category, conduct a thorough review of the nitrogen fertilization program to determine where improvements could be made.

Plant Nitrogen Status	Stalk Nitrate (ppm)	Management Suggestions
Low	0-250	High probability that Nitrogen is deficient
Marginal	250-700	Nitrogen Management should be re-evaluated
Optimal	700-2000	Yields are not limited by Nitrogen
Excessive	Greater than 2000	Nitrogen supply greater than needed.

For additional information refer to Iowa State University Extension Publication CROP 3154 *"Use of the End-of-Season Cornstalk Nitrate Test"* available at: https://store.extension.iastate.edu/Product/5089.

Note: This option must be contracted for more than one year.

4. Split Nutrient Applications.

- Apply no more than 50% of total crop nitrogen needs within 30 days prior to planting (or in the case of hay or pasture after the green up of dormant grasses). Apply the remaining nitrogen after crop emergence (or green up).
- Post emergent nitrogen may be reduced based on crop scouting, in-season soil sample/analysis, or plant tissue sampling analysis.

5. Time Nutrient application timing to match uptake time.

- Apply nutrients no more than 30 days prior to planting date of annual crops.

6. Nutrient application placement below soil surface

- Fertilizer is injected or incorporated at time of application.

Documentation Requirements

Participant will:

1. Provide copies of soil test results for each field. At a minimum, results for N-P-K and organic matter will be provided.
2. As applicable, provide copies of manure analysis, irrigation water analysis, etc.
3. Provide a nutrient budget for each field including yield goal and planned nutrient applications. Complete the nutrient budget sheet below or provide equivalent documentation.
4. Provide records for actual nutrient applications (N-P-K). Include planting date and actual yield. Complete the nutrient application table below or provide equivalent documentation.
5. Indicate which strategies and/or technologies will be used for this enhancement for each field. Include additional records for specific technologies:
   a. In-season nitrate sampling - include test results and adjustments in nutrient management based on results.
   b. In-season plant tissue sampling and analysis - include type of test used, results including reference strips if required, and adjustments made in nutrient management based on results.
   c. Nutrient application placement below soil surface - include method of injection or incorporation and depth.

NUTRIENT APPLICATION RECORDS

Field Information				Commercial Fertilizer and Manure Information							
Tract, Field	**Acres**	**Previous Crop, Planned Crop, Planting Date**	**Yield Goal, Actual Yield**	**Type of Fertilizer or Manure Applied**	**Application Date**	**Application Rate**	**Application Method**	**If Manure, Days to Incorp.**	**Available N (lbs/ac)**	**Available P_2O_5 (lbs/ac)**	**Available K_2O (lbs/ac)**
Example: T123 Field 1	*40*	**Prev. Crop** *Soybeans*	**Yield Goal**	*32-0-0*	*4/1/2017*	*15 gals/ac*	*broadcast*		*53*	*0*	*0*
		Crop *Corn*	*150*	*10-34-0*	*4/25/2017*	*5 gals/ac*	*In furrow*		*5.7*	*19.4*	*0*
		Planting Date *4/25/2017*	**Actual Yield** *145*	*32-0-0*	*5/15/2017*	*15 gals/ac*	*surface banded*		*53*	*0*	*0*
		Prev. Crop	**Yield Goal**								
		Crop									
		Planting Date	**Actual Yield**								
		Prev. Crop	**Yield Goal**								
		Crop									
		Planting Date	**Actual Yield**								
		Prev. Crop	**Yield Goal**								
		Crop									
		Yield Goal	**Actual Yield**								
		Prev. Crop	**Yield Goal**								
		Crop									
		Planting Date	**Actual Yield**								

NUTRIENT BUDGET

1) Field Information – Attach Field Map with boundaries and management zones

Producer		**Crop Year**	
Field Name		**Prior Crop**	
Tract No. / Field No.		**Planned Crop**	
Management Zone		**Yield Goal**	
Acres		**Cover Crop**	
Type of Soil Test (Grid or Zone) and Number of samples			

2) Soil Sampling Results – Include copy of soil test report

	Nitrogen (N) (ppm)			P (ppm)	K (ppm)	[1]OM (%)	pH
	Layer 1	Layer 2	Layer 3				
Soil Test Values							
Bottom Layer (in.)							

3) Nutrient Budget

	Nutrients				**Calculations/Comments**
RECOMMENDATIONS	N	P_2O_5	K_2O		
Requirements (lb/a) NEEDS					
CREDITS (lb./a)					
Soil Test N Residual					
Organic Matter ([1]OM) Nitrogen					[1]OM% is capped at 3.0%
Irrigation Water N (____ inches)					80% of avg. Irrigation water applied
Legume (type:_____)					
Cover Crop (type:_____)					Grazed/cut?
Organic N Value for Prior Manure					
Date Applied / Type / Rate Applied					
Total Credits (from above)					
Nutrient Recommendations					(Needs minus Total Credits)

4) Planned / Recommended Nutrient Application for Planned Crop

Source	Form	Timing (mo/d/yr)	Method (f Manure-Days to incorp.)	Total Rate Applied /A	Actual Nutrients (lb./a)			
					N	P	K	
TOTAL NUTRIENTS APPLIED (lb./A)								

Nitrification Inhibitor planned (if yes, name)?: _____

5) Actual Applied Nutrients

Source	Form	Timing (mo/d/yr)	Method (Manure-Days to incorp)	Total Rate Applied /A	Actual Nutrients (lb./a)			
					N	P	K	
TOTAL NUTRIENTS APPLIED (lb./A)								

Nitrification Inhibitor planned (if yes, name)?:_____ ACTUAL YIELD: _____

6) Application Equipment Calibration

Equipment Type	Date

Certified by: _____ Date: _____